MOBILITY DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a divisional of U.S. patent application Ser. No. 15/600,703, filed on May 20, 2017 entitled MOBILITY DEVICE (Atty. Dkt. No. U22), which is a continuation-in-part of U.S. patent application Ser. No. 15/441,190, filed on Feb. 23, 2017 entitled MOBILITY DEVICE CONTROL SYSTEM (Atty. Dkt. No. U76), and a continuation-in-part of U.S. patent application Ser. No. 15/486,980, entitled USER CONTROL DEVICE FOR A TRANSPORTER, filed on Apr. 13, 2017 (Atty. Dkt. No. V13), which are incorporated herein by reference in their entirety. This application claims the benefit of U.S. Provisional Application Ser. No. 62/339,723, filed May 20, 2016, entitled POWERED TRANSPORTER BASE (Attorney Docket No. S04), and U.S. Provisional Application Ser. No. 62/403,030 filed Sep. 30, 2016, entitled POWERED TRANSPORTER (Attorney Docket No. S42), which are incorporated herein by reference in their entirety.

BACKGROUND

[0002] The present teachings relate generally to mobility devices, and more specifically to control systems for vehicles that have heightened requirements for safety and reliability.

[0003] A wide range of devices and methods are known for transporting human subjects experiencing physical incapacitation. The design of these devices has generally required certain compromises to accommodate the physical limitations of the users. When stability is deemed essential, relative ease of locomotion can be compromised. When transporting a physically disabled or other person up and down stairs is deemed essential, convenient locomotion along regions that do not include stairs can be compromised. Devices that achieve features that could be useful to a disabled user can be complex, heavy, and difficult for ordinary locomotion.

[0004] Some systems provide for travel in upright positions, while others provide for ascending or descending stairs. Some systems can provide fault detection and operation after a fault has been detected, while others provide for transporting a user over irregular terrain.

[0005] The control system for an actively stable personal vehicle or mobility device can maintain the stability of the mobility device by continuously sensing the orientation of the mobility device, determining the corrective action to maintain stability, and commanding the wheel motors to make the corrective action. Currently, if the mobility device loses the ability to maintain stability, such as through the failure of a component, the user may experience, among other things, discomfort at the sudden loss of balance. Further, the user may desire enhanced safety features and further control over the reaction of the mobility device to unstable situations.

[0006] What is needed is a reliable, lightweight, and stable mobility device that includes an automatic response capability to situations that are commonly encountered by a disabled user such as, for example, but not limited to positional obstacles, slippery surfaces, tipping conditions, and component failure. What is further needed is a mobility device having long-lived redundant batteries, ergonomically positioned and shock buffered caster wheel assemblies, and ride management bumpers. What is still further needed is a mobility device that includes automatic mode transitions, improved performance over other mobility vehicles, remote control, and a vehicle locking mechanism. The mobility device should also include foreign substance sealing and sloping management, a cabled charging port, and accommodations for an increased payload over the prior art.

SUMMARY

[0007] The powered balancing mobility device of the present teachings can include, but is not limited to including a powerbase assembly processing movement commands for the mobility device, and at least one cluster assembly operably coupled to the powerbase assembly, the at least one cluster assembly being operably coupled to a plurality of wheels, the plurality of wheels supporting the powerbase assembly, the plurality of wheels and the at least one cluster assembly moving the mobility device based at least on the processed movement commands. The mobility device can include an active stabilization processor estimating the center of gravity of the mobility device, the active stabilization processor estimating at least one value associated with the mobility device required to maintain balance of the mobility device based on the estimated center of gravity. The powerbase processor can actively balance the mobility device on at least two of the plurality of wheels based at least on the at least one value. The powerbase assembly can optionally include redundant motors moving the at least one cluster assembly and the plurality of wheels, redundant sensors sensing sensor data from the redundant motors and the at least one cluster assembly, redundant processors executing within the powerbase assembly, the redundant processors selecting information from the sensor data, the selecting being based on agreement of the sensor data among the redundant processors, the redundant processors processing the movement commands based at least on the selected information.

[0008] The powered balancing mobility device can optionally include an anti-tipping controller stabilizing the mobility device based on stabilization factors, the anti-tipping controller executing commands including computing a stabilization metric, computing a stabilization factor, determining movement commands information required to process the movement commands, and processing the movement commands based on the movement command information and the stabilization factor if the stabilization metric indicates that stabilization is required. The powered balancing mobility device can optionally include a stair-climbing failsafe means forcing the mobility device to fall safely if stability is lost during stair climbing. The powered balancing mobility device can optionally include a caster wheel assembly operably coupled with the powerbase assembly, a linear acceleration processor computing mobility device acceleration of the mobility device based at least on the speed of the wheels, the linear acceleration processor computing the inertial sensor acceleration of an inertial sensor mounted upon the mobility device based at least on sensor data from the inertial sensor, a traction control processor computing the difference between the mobility device acceleration and the inertial sensor acceleration, the traction control processor comparing the difference to a pre-selected threshold, and a wheel/cluster command processor commanding the at least one cluster assembly to drop